

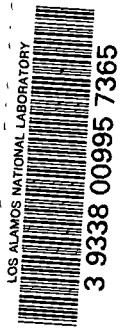
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Title: FINE SSE, A Neutrino Scattering Experiment (U)

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Form 836 (8/00)



FINeSSE, a neutrino scattering experiment

(1) Physics

- neutrino-nucleon elastic scattering, Δs
- other neutrino scattering processes (CCQE, CCp, NCp)
- neutrino-oscillations (requires a "far" detector)

(2) What is Δs ?

Strange quark spin component in the nucleon

(3) Why ν NC ?

Information about Δs exists in the isoscalar part of the axial form factor

$$\langle N | A_\mu^z | N \rangle = -\frac{G_F}{\sqrt{2}} \frac{1}{2} \langle N | \bar{u} \gamma_\mu \gamma_5 u - \bar{d} \gamma_\mu \gamma_5 d - \bar{s} \gamma_\mu \gamma_5 s | N \rangle$$

$$= -\frac{G_F}{\sqrt{2}} \frac{1}{2} \langle N | -G_A(Q^2) \gamma_\mu \gamma_5 \tau + G_A^s(Q^2) \gamma_\mu \gamma_5 | N \rangle$$

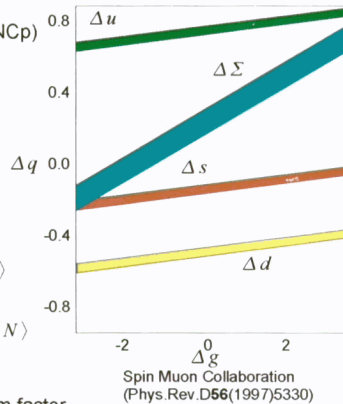
isovector
isoscalar

and low- Q^2 ν scattering is most sensitive to axial form factor, so a measurement of ν N NC scattering yields Δs .

- PV electron scattering not sensitive to axial form factor.
- best measured via a ratio, $R(\text{NC}/\text{CC})$.

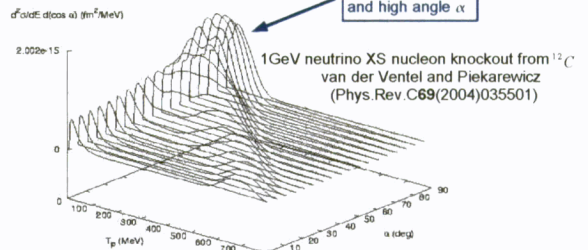
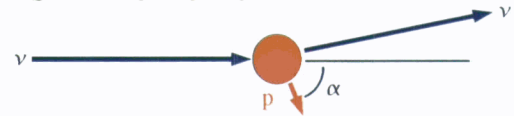
$$R(\text{NC}/\text{CC}) \equiv \frac{\sigma(\nu p \rightarrow \nu p)}{\sigma(\nu n \rightarrow \mu p)}$$

Using the neutrino beam as probe of nucleon structure.



(4) Why Scibath?

low Q^2 scattering is high angle event



so typical forward type detector doesn't work well for this physics

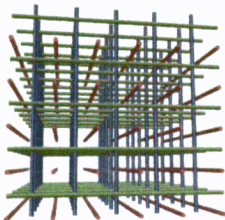
need high sensitivity to high angle event (not only forward)

non-segmented isotropic liquid scintillator detector

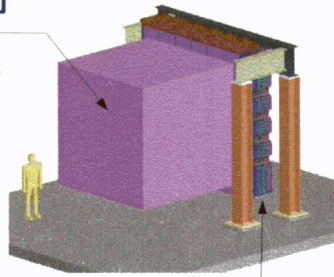
FINeSSE detector

The Vertex Detector...

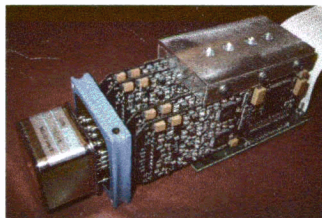
- to precisely track low-energy protons
- (2.5m)² active liquid scintillator volume
- 19200 (80x80x3) 1.5 mm VLS fibers on 3cm spacing with 3 orientations



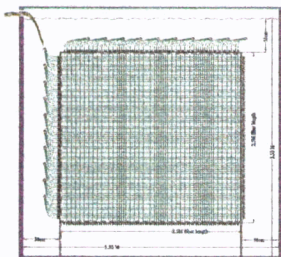
Vertex Detector, fiber orientation



The Muon Rangestack...
- to track and measure the energy of muons



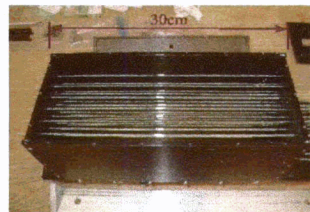
Read out PMT and front-end electronics



Vertex detector, side view

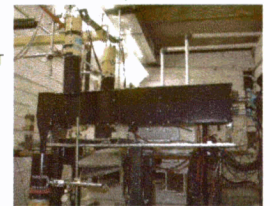
Prototype beam test

A prototype detector was tested using the 200MeV proton beam at the Indiana University Cyclotron Facility with, Liquid Scintillator : BC-517H blue to green fiber : BCF-91A



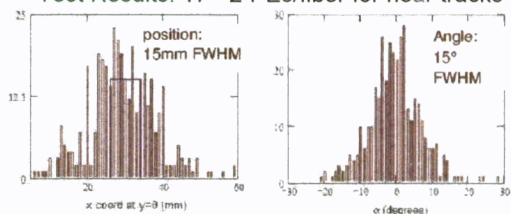
Read out by 16ch. MAPMT (H8711)

Beam test setup



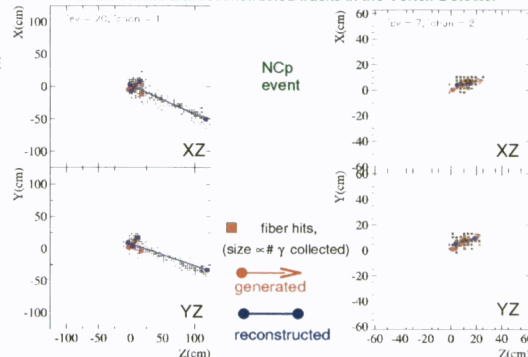
beam comes through the detector from backside of this picture

Test Results: 17+/-2 PE/fiber for near tracks

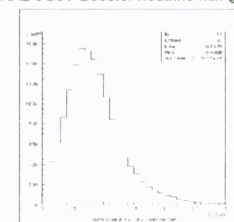


measured coordinate resolution

simulated hits and reconstructed tracks in the Vertex Detector



FNAL 8GeV Booster neutrino flux @ 100m



Low-energy, high-intensity ν beam needed.

Possible sites:

- FNAL
- BNL
- JPARC

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